METHODS AND SYSTEMS FOR ACCESSING PEG COUNT INFORMATION GENERATED BY SIGNALING GATEWAY OR SIGNAL TRANSFER POINT

AN APPLICATION FOR

UNITED STATES LETTERS PATENT

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"Express Mail" mailing number EL863577785US
Date of Deposit December 12, 2001
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Description

METHODS AND SYSTEMS FOR ACCESSING PEG COUNT INFORMATION GENERATED BY SIGNALING GATEWAY OR SIGNAL TRANSFER POINT

Related Applications

This application claims the benefit of U.S. provisional patent application serial no. 60/255,038, filed December 12, 2000, the disclosure of which is incorporated herein by reference in its entirety.

Technical Field

The present invention relates to methods and systems for collecting information generated by a signaling gateway or signal transfer point. More particularly, the present invention relates to methods and systems for collecting usage measurements, such as peg counts, generated by a signal transfer point or signaling gateway.

Related Art

Signaling message routing nodes, such as signaling gateways and signal transfer points, typically include internal processing modules that process and route signaling messages. As used herein, the phrase "signaling message" is intended to refer to any message associated with network management or the setup, teardown, routing, or control of a call. Examples of signaling messages

include SS7 signaling messages, SIP signaling messages, etc. These internal processing modules also generate peg count information based on signaling messages that they receive or process. Examples of such peg count information include the number of signaling messages having a particular originating point code, a particular destination point code, a particular circuit identification code, or other signaling message parameters.

This peg count information was conventionally accessed by an operations, administration, and maintenance module (OA&M) internal to the signal transfer point. The OA&M module polled the other internal processing modules to obtain the signaling information. The OA&M module then communicated the peg count information to an external proprietary interface box via a serial link. One example of such a proprietary interface is the SEAS™ interface available from Telcordia Technologies of Piscataway, New Jersey.

This method for accessing peg count information collected by a signaling gateway or a signal transfer point is undesirable for a variety of reasons. For example, the external proprietary interface module is only available from a limited number of vendors and can cost over $1 million. Another disadvantage associated with communicating peg count information to a proprietary interface module is that such communication is typically slow.

Yet another problem with the conventional methods for collecting peg count information that required an external proprietary interface is that the methods were not scalable. Because peg count information was collected by a single OA&M module that served multiple internal processing modules, the rate at which peg count information could be collected was limited by the processing capability of the OA&M module. Since the OA&M module performed other

functions in addition to peg counting, conventional methods for collecting peg count information were limited in terms of performance.

Yet another problem associated with conventional peg counting systems is that these systems produced only static reports defined in system software. Generating new types of reports required software to be changed and re-compiled. Such a method for changing reports is inefficient because it required intervention of the manufacturer of the peg counting system for even minor changes to report content or format.

Accordingly, there exists a long-felt need for methods and systems for efficiently generating and accessing peg count information that avoids the difficulties associated with conventional systems.

Disclosure of the Invention

The present invention includes improved methods and systems for generating and accessing peg count information in a network routing node, such as a signal transfer point or signaling gateway. As used herein, the term "peg counts or peg count information" refers to information that includes the number of messages or octets of a particular type, having a particular parameter or parameters, from a particular source, to a particular destination, or any other information used to evaluate the capacity or utilization of a network routing node, such as a signal transfer point or signaling gateway. Exemplary peg count information that may be collected by the present invention is described in GR-82-CORE, Signaling Transfer Point (STP) Generic Requirements, Issue 4, December 2000, Telcordia Technologies, the disclosure of which is incorporated herein by reference in its entirety.

A typical signal transfer point or signaling gateway includes one or more internal signaling message processing modules that generate peg count information based on received or processed signaling messages. According to the present invention, a usage measurements module, separate from the operations, administration, and maintenance module, polls the internal processing modules for the peg count information. The usage measurements module then communicates the stored peg count information to an external device via a TCP/IP connection. The usage measurements module may also forward the peg count information to an internal permanent storage medium, such as a disk storage medium.

Providing a usage measurements module separate from the OA&M module that collects peg count information and communicates the peg count information to an external device is advantageous for a variety of reasons. For example, because the peg count information is communicated over an external TCP/IP connection, the need for an external proprietary interface device is eliminated. The proprietary interface device can be replaced by a general-purpose computer that receives and processes the peg count information. Such a computer may include network monitoring and/or billing applications that perform monitoring or billing functions based on the received peg count information. In addition, because TCP/IP links can be run over fast local area network connections, such as fast Ethernet, FDDI, or other local area network technologies, the speed at which peg count information is reported is increased.

According to another aspect of the invention, a method for load sharing between usage measurement modules is provided. A signaling gateway or signal transfer point may include a primary usage measurements module and

one or more secondary usage measurements modules. The primary usage measurements module maintains a query list and distributes portions of the query list to each of the secondary usage measurements modules. The secondary usage measurements modules query individual processing modules for usage measurements based on their respective portions of the query list. The secondary usage measurements modules receive usage measurements from the internal processing modules and forward the usage measurements to the primary usage measurements module. The primary usage measurements module generates one or more reports based on the data received from the secondary usage measurements module and any data that the primary usage measurements module may have collected from other internal processing modules. The primary usage measurements module forwards the reports to the external processing platform via a high-speed network connection. Because usage measurements connection functionality is distributed among multiple processors or cards, the overall time for collecting usage measurements is reduced. In addition, the measurements capacity of the routing node is increased over conventional systems where a single operations, administration, and maintenance module was responsible for collecting the peg count information.

According to yet another aspect, the invention includes a report generator for generating user-configurable reports. The user may access a report template generator via a user interface and select parameters to be included in a report. The report template generator may verify that the report includes required attributes or parameters. If the report does not include the required parameters, report template generator may reject the report. If the report

includes the required parameters, report template generator may forward the report to the report generator.

The report template generator may also allow the user to select whether to enable or disable the report. Enabled reports are sent to the report generator. Disabled reports may be stored for later use. The report generator may forward enabled reports to a report scheduler. The report scheduler schedules generation of the enabled reports. Because the present invention includes mechanisms for end users to define, alter, enable, and disable reports with requiring software upgrades, the report generation capability of the present invention provides increased flexibility over conventional static solutions.

Brief Description of the Drawings

Preferred embodiments of the present invention will now be explained with reference to the accompanying drawings, of which:

Figure 1 is a block diagram of a routing node including a usage measurements module according to an embodiment of the present invention;

Figure 2 is a block diagram of an exemplary communication link module **102** or **104** illustrated in Figure 1;

Figure 3 is a block diagram of an exemplary internal processing module **106** illustrated in Figure 1;

Figure 4 is a block diagram of an exemplary usage measurements module **134** illustrated in Figure 1;

Figure 5 is a block diagram of primary and secondary usage measurements modules illustrating a method for load sharing between usage measurements modules according to an embodiment of the present invention;

and

Figure 6 is a block diagram of exemplary components of a usage measurements module for generating user-configurable measurements reports according to an embodiment of the present invention.

Detailed Description of Preferred Embodiments

Figure 1 illustrates an exemplary internal architecture of a signaling gateway including a usage measurements module according to an embodiment of the present invention. In Figure 1, signaling gateway or STP **100** includes a plurality of modules for processing signaling messages. In the illustrated example, the modules include communication link modules (CLMs) **102** and **104**, an internal processing module (IPM) **106**, a CLM **108**, and an OA&M module **110**. Communication link modules **102** and **104** send and receive signaling messages from signaling points **112**, **114**, **116**, and **118** via signaling links **120**, **122**, **124**, and **126**. Communication link modules **102** and **104** perform signaling levels 1-3 processing on received signaling messages, which includes routing received signaling messages to other modules internal to signaling gateway **100** for further processing. Communication link modules **102** and **104** may also perform layer 4 and above processing on received signaling messages, depending on the internal architecture of signaling gateway **100**.

IPM module **106** performs SCCP/TCAP and other layer 4 and above processing of signaling messages received from communication link modules **102** and **104**. Examples of such layer 4 and above processing includes global title translation, number portability translation, mobile query message processing, such as MAP screening, HLR/SMSC query message processing,

etc. Signaling messages are communicated between the processing modules of signaling gateway **100** via interprocessor message transport (IMT) bus **128**.

Communications link module **108** sends signaling messages to and receives signaling messages from external devices, such as database **130**, via a signaling link **132**. Accordingly, CLM **108** may include a TCP/IP protocol stack or a UDP/IP protocol stack for transferring such messages. In addition, if the signaling protocol is not compatible with TCP/IP or UDP/IP, CLM **108** may translate between TCP/IP and UDP/IP and the signaling protocol. For example, if the signaling protocol is SS7, which includes its own lower layer protocol stack, CLM **108** may translate between the lower layers of SS7 and TCP/IP or UDP/IP. A detailed description of exemplary functionality of CLM **108** can be found in PCT Publication No. WO 00/35155, the disclosure of which is incorporated herein by reference in its entirety. In an alternate embodiment, CLM **108** may implement the stream control transmission protocol, for example as described in IETF RFC 2960: "Stream Control Transmission Protocol," the disclosure of which is incorporated herein by reference in its entirety.

Communication link modules **102** and **104**, internal processing module **106**, and communication link module **108** generate peg count information based on received signaling messages, including SS7 and IP-based signaling messages. This peg count information has conventionally been communicated to OA&M module **110** at predetermined intervals. OA&M **110** then communicates the peg count information to an external proprietary interface box. Using an external proprietary interface box has a number of disadvantages that are discussed above.

According to the present invention, a new usage measurements module

134 is provided. Usage measurements module **134** polls internal processing modules of signaling gateway **100** to collect the peg count information at predetermined intervals. Usage measurements module **134** then communicates the peg count information to an external processing platform **136** via high-speed link **138**. External message processing platform **136** may be a personal computer or workstation including an Ethernet or other local area network card. Using this configuration rather than an external proprietary interface box greatly reduces the time and expense of collecting peg count information.

Signaling gateway **100** may also include a permanent storage device **140** for receiving usage measurements, such as peg counts, from UMM **134**. Providing permanent storage internal to signaling gateway **100** may be advantageous as a backup for the temporary storage provided on the other internal processing modules, especially when the information is being used for billing or accounting purposes. Alternatively, UMM **134** may forward the peg count information to OA&M module **110**, which may include a permanent storage device so that the backup peg count information may be stored by OA&M module **110**.

Figure 2 is a functional block diagram of an exemplary communication link module **102** illustrated in Figure 1. In Figure 2, communication link module **102** includes OSI layer 2 (data link) functionality, such as MTP2/SAAL layer **200**, OSI layer 3 (network) functionality, such as MTP3 layer **202**, gateway screening module **204**, current measurement data store **206**, and previous measurement data store **208** located in memory **210**. MTP2/SAAL layer **200** performs MTP2 or SAAL processing of received messages, as appropriate. As the messages pass through layer **200**, MTP2/SAAL layer **200** generates peg counts based on

these lower level messages. Exemplary lower level measurements or peg counts that may be recorded include messages received in error, or link controlled events, such as out of service indications. Such measurements may be stored in local memory **210** on CLM **102**.

Incoming messages that include components above the MTP2/SAAL layer may be passed to MTP3 layer **202**. MTP3 layer **202** performs MTP3 functions, such as message routing. In addition, MTP3 layer **202** may generate measurements that can be derived from MTP3 information in received messages. Exemplary measurements that may be recorded by MTP3 layer **202** include the number of messages and octets terminated by the signal transfer point or signaling gateway, the number of messages and octets through switched by signal transfer point or signaling gateway, the number of messages requiring global title translation, or other internal processing by the signal transfer point or signaling gateway.

Following the processing by MTP3 layer **202**, an incoming message may pass through gateway screening module **204**. Gateway screening module **204** may screen messages based on one or more parameters in the messages, such as the destination point code. In addition, gateway screening module **204** may generate measurements based on screening actions, such as the number of messages screened for a particular point code or the number of messages passed for a particular point code.

Measurements collected by layers **200**, **202**, and **204** may be stored in current measurement data store **206** or previous measurement data store **208**, depending on when the measurements were obtained. The measurement data collected by the components illustrated in Figure 2 may include a collection of

period-entity specific data that varies with CLM application. Typical sets of data that may be collected include five minute STP data, five minute link data, thirty minute STP data, thirty minute link data, thirty minute link set data, etc. For each period-entity data set, two data stores are maintained: current data and previous data. The current data may be compared with previous data to indicate whether the volume of messages handled by a routing node is increasing and whether capacity of one or more subsystems of the routing node needs to be increased.

Figure 3 illustrates an example of IPM **106** illustrated in Figure 1. In Figure 3, IPM **106** includes a plurality of internal processing modules that perform SCCP and higher layer processing of signaling messages. In this example, GTT and LNP modules are illustrated. It is understood that IPM **106** may perform functions other than global title translation and local number portability. For example, in an alternate embodiment, IPM **106** may include an HLR/SMSC query routing database, a mobile number portability database, and/or an international number portability database.

In the illustrated example, IPM **106** includes a global title translation database **300** for storing global title translation information, a mobile application part (MAP) database **302** for storing MAP information used in MAP screening, and a local number portability database **304** for storing local number portability translation information. IPM **106** also includes a plurality of tables that perform processing functions related to global title translation and local number portability processing. In particular, IPM **106** includes an LNP translation type table **306** for storing LNP translation types and a subsystem number application table **308** for storing subsystem numbers of subsystems present on IPM **106**.

With regard to LNP processing, IPM **106** includes LNP query service

module **312** and LNP message relay module **314**. LNP query service module **312** performs lookups in LNP database **304**. LNP query service module **312** also records measurements based on responses from LNP database **304**. For example, LNP query service module **312** may record measurements, such as LNP queries received, LNP queries discarded, initial results, non-ported NPA-NXX lookups, and ported LRN lookups. LNP message relay module **314** relays LNP response messages to querying entities.

With regard to message routing, IPM **106** includes an MTP routing module **316** for routing incoming and outgoing query messages. In addition to MTP routing capabilities, IPM **106** includes a signaling connection routing controller (SCRC) **318** for performing SCCP routing functions. SCRC **318** may also record measurements related to global title translations, such as global title translations performed and global title translations failed.

With regard to management functions, IPM **106** includes an SCCP management module **320** for performing SCCP management functions, a subsystem management module **322** for managing the LNP subsystem, and an operations, administration, and maintenance module **324** for interfacing with OA&M module **110** illustrated in Figure 1. In one embodiment, operations, administration, and maintenance module **324** may collect measurements from LNP query service module **312** and SCRC **318** and forward the measurements to OAM **110**. However, because UMM module **134** automatically collects such measurements and forwards the measurements to external processing platform **136**, the measurement functionality of OAM **324** is an optional feature and may not be necessary.

Figure 4 is a functional block diagram of UMM **134** according to an

embodiment of the present invention. In Figure 4, UMM **134** includes a poller **400** for polling internal processing modules **106** and communication link modules **102**, **104**, and **108** to obtain measurements collected by those modules. An entity collection controller **402** initiates poling for specific period entity data sets from CLM and IPM cards in the signal transfer point or signaling gateway. When entity collection controller **402** receives data from all of the internal processing modules and communication link modules, entity collection controller **402** processes the data, aggregates linkset and STP totals and stores the data in RAM. Entity collection controller **402** notifies measurement report controller **404** and redundancy manager **406** when collection and response to a particular poll is complete.

Measurement report controller **404** extracts relevant period-entity data for each required report, formats the data, and submits a transfer request to file transfer application **408**. The reports generated by measurement controller **404** may be of a set format or a user-defined format.

File transfer application **408** may determine the availability of configured external applications for receiving measurements from UMM **134**. For example, file transfer application **408** may be an FTP client. File transfer application **408** may communicate with an external FTP server, for example, residing on external message processing platform **136**. In order to communicate with an external device, file transfer application **408** may utilize operating system provided services **410**, such as FTP and TCP/IP.

<u>Load Sharing and Scalability</u>

According to another aspect of the invention, UMMs **134** perform load-

sharing operations to distribute the measurement collection functionality of the present invention among multiple processors. Such load sharing allows the measurements capabilities of a routing node, such as signaling gateway **100** to be scaled with the message processing functionality.

Figure 5 is a block diagram of a primary UMM **134A** and a secondary UMM **134B** illustrating the load sharing functionality of UMMs according to an embodiment of the present invention. Referring to Figure 5, in order to control collection of measurements, primary UMM **134A** maintains a master query list **500** that stores measurement queries to be distributed to other UMMs, such as secondary UMM **134B**. As used herein, the term "measurement query" refers to a message that may be sent by a UMM to an internal processing module requesting measurements for a particular time interval, such as all STP or link data for a particular 30 minute period. Each UMM collects usage measurements from CLMs **102, 104,** and **108** and IPMs **106** according to the queries in each card's query list, indicated by reference numeral **502.** By distributing portions of master query list **500** among multiple UMMs, the present invention reduces the overall measurements collection time and increases the scalability of a routing node, such as signaling gateway **100**.

The UMMs collect stored data from the IPMs and CLMs for the most recent previous period for each entity for which the source card maintains peg counts, e.g., the CLMs may maintain separate storage for STP, LINK, LINKSET, linkset destination network indicator (LSDESTNI), and linkset origination network indicator (LSORIGNI) data. The query lists may be divided by logical entities, e.g. one query list may contain queries for all STP data, another query list may contain queries for all LSDESTNI data, or query lists may be divided by selected

internal processing modules or CLMs.

In order to control the collection of measurements by multiple cards, primary UMM **134A** includes a data accumulator **504** and a query controller/allocator **506**. Data accumulator **504** collects polling data from all secondary UMMs, such as secondary UMM **134B** and stores the data in master data store **508**, which may be located in RAM on primary UMM **134A**. Query controller/allocator **506** controls primary data accumulator **504**, primary entity collection controller **502**, and determines the portions of master query list **500** to be distributed to each UMM.

Secondary UMM **134B** includes a query controller **510**, and a data accumulator **512**. Query controller **510** on secondary UMM **134B** controls secondary data accumulator **512** and entity collection controller **402** on secondary UMM **134B**. Data accumulator **512** accumulates data collected by secondary UMM **134B** and stores the data in master data store **508** of UMM **134B**. Secondary UMM **134B** may optionally include a report controller **404**, an FTP application **408**, and OS provided services **410**. However, these functions may be disabled or not used on secondary UMM **134B** since reporting to external processing platform **136** may be performed by primary UMM **134A**.

Measurement Collection

At the start of a measurement collection cycle, query controllers **506** and **510** on UMMs **134A** and **134B** instruct their respective entity collection controllers **402** to initiate polling for the items in their respective query lists **502** from CLM and IPM cards. The IPM and CLM cards receive the queries and forward the requested peg count information to the querying UMM via IMT bus

128 illustrated in Figure 1. Each entity collection controller **402** receives the peg count information and forwards the peg count information to data accumulator **504**, which stores the data as it is being collected. When collection is complete, each UMM's entity collection controller **402** notifies its respective query controller **506, 508**. Query controllers **506** and **508** notify data accumulators **504** and **510** and query controller/allocator **506** that polling is complete.

For secondary UMMs, such as secondary UMM **134B**, data accumulator **512** sends received peg count information to data accumulator **504** and master data store **508** of primary UMM **134A**. The polling data may also be written to data area **508** of secondary UMM **134B** to reduce the likelihood of data loss when transferring data to data accumulator **504** of primary UMM **134A**.

Data accumulator **504** of primary UMM **134A** collects and stores poll data from secondary UMMs. When the data transfer is complete, secondary data accumulator **512** notifies secondary query controller **510**. Secondary query controller then notifies query controller/allocator **506** of primary UMM **134A** that data transfer is complete.

Once data accumulator **504** of primary UMM **134A** has all of the peg count information collected for a particular poll, this data is written to master data memory **508** on primary UMM **134A** and is then submitted to redundancy manager **406** of primary UMM **134A** where it is copied to master data stores on each secondary UMM. The polling data may also be written a local hard disk on permanent storage module **140** for persistent measurement data retention due to a power loss.

Once data has been stored in master data **508**, report controller **404** of primary UMM **134A** extracts data for the relevant period specified by a report,

formats the data and sends each report to file transfer application **408**. File transfer application **408** forwards the data to external processing platform **136** over a high bandwidth link, such as a TCP/IP over Ethernet link, in the manner described above.

As discussed above, redundancy manager **406** of primary UMM **134A** is responsible for copying the data to master data of each secondary UMM via redundancy manager **406** of each secondary UMM. Redundancy manager **406** of primary UMM **134A** also keeps track of card status and in the event of failure of primary UMM **134A**, transfers the role of primary UMM **134A** to one of the secondary UMMs. Redundancy manager **406** may also modify the query lists in this event. For example, redundancy manager **406** may inform the query manager to redistribute queries previously assigned to a failed UMM. Redundancy manager **404** of primary UMM **134A** may also conduct audits to verify the data integrity of other UMMs.

<u>Configurable Measurement Reports</u>

According to another aspect of the invention, a UMM may include configurable measurement report generation capabilities. Figure 6 is a block diagram illustrating exemplary components of primary UMM **134A** associated with configurable report generation according to an embodiment of the present invention. In Figure 6, primary UMM **134A** can be configured by a user interface **600**, which may be a web interface, that allows a user, such as a network operator, to provision configurable reports on UMM **134A**. A report template generator **602** may compare reports generated using user interface **600** against a standard template to ensure that each report contains predetermined

attributes, such as usage measurements required by industry standards. Report template generator **602** may accept or reject a custom report based on whether the report includes all of the required attributes.

If the report is accepted by report template generator **602**, the requested report and its attributes are forwarded to report data tables manager **604**. Report data tables manager **604** stores the name of each report and indexes the name to the attributes of the report. Report data tables manager **604** may also determine reports that are active and inactive. An active report, as used herein, is a report that will be generated by UMM **134A**. An inactive report is a report stored in tables managed by report data tables manager **604**, but for which a report may not be generated. A user may select via user interface **600** whether a report is active or inactive without affecting the generation of other reports.

One example of a user configurable report may be a collective LINK network data collection (NDC) report. In one prior fixed report generation application, LINK measurement data is divided among two industry-defined reports: a component and maintenance daily report and a vendor-specific availability report. The end user may elect to create a single report to capture all LINK data in a single report. Conversely, the user may elect to define a report for link usage that contains only the registers for messages and octets transmitted and received. Generating any type of user-defined measurements report is intended to be within the scope of the invention.

Report data tables manager **604** stores all report definitions for use by report scheduler **608** and report generator **606**. Report scheduler **606** initiates active report requests based on the configurable time period to report generator **606** to build custom reports from measurement data stored by primary UMM

134A. Report scheduler **606** may also notify file transfer application **408** that a custom report has been requested and should be produced. Report generator **608** builds and forwards the custom report to file system **610**. File transfer application **408** then requests a file transfer and forwards the reports from file system **610** to external processing platform **136**. Because the present invention include configurable report generation capabilities, report content can be changed without a software upgrade to a routing node, such as signal transfer point or signaling gateway.

It will be understood that various details of the invention may be changed without departing from the scope of the invention. Furthermore, the foregoing description is for the purpose of illustration only, and not for the purpose of limitation—the invention being defined by the claims.